

Application Report

Typical Design Guidelines for TPS92630/8-Q1 in Automotive Rear Lamp Applications



Shirley He

ABSTRACT

The TPS92630-Q1 and TPS92638-Q1 devices are automotive 3-channel and 8-channel constant-current linear LED drivers designed for high-brightness LEDs in automotive rear lamp applications. This application report describes the design guidelines for the TPS92630/8-Q1 device to ensure normal operation under drooping input voltage conditions.

Table of Contents

1 Introduction.....	2
2 Supply Line Transients In Automotive Rear Lamp Applications.....	3
3 Recommended Circuit For Device Enable Control.....	3
4 Implementation Results.....	4
5 Summary.....	5

Trademarks

All other trademarks are the property of their respective owners.

1 Introduction

Figure 1-1 and Figure 1-2 shows the typical application schematics of the two devices. The VIN pin for TPS92630-Q1 and the SUPPLY pin for TPS92638-Q1 are power supply input pins. The voltage of the supply pins are expressed as V(supply) hereinafter. The supported supply voltage range of TPS92630/8-Q1 is 5 V - 40 V.

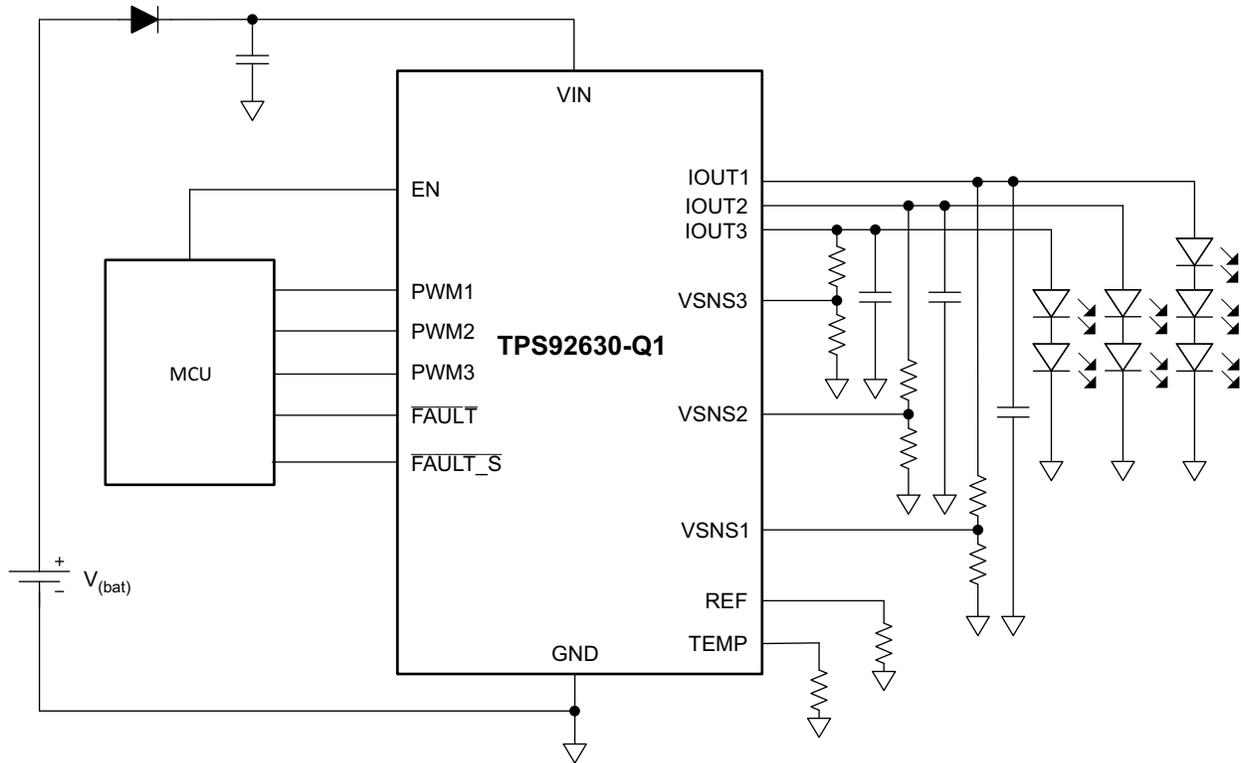


Figure 1-1. TPS92630-Q1 Typical Application Schematic

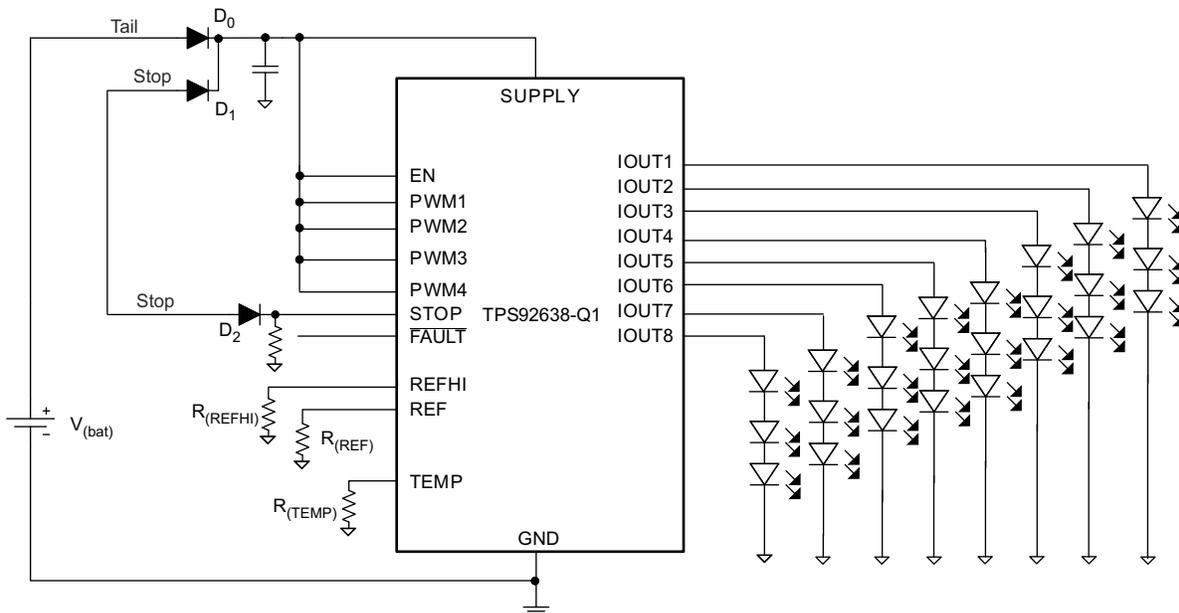


Figure 1-2. TPS92638-Q1 Typical Application Schematic

Both devices have full-diagnostic and built-in protection capabilities, such as output short-to-ground detection, open-load detection and reference resistor short detection. The fault detection features are effective when the device is enabled ($V_{(EN)} > 2\text{ V}$).

2 Supply Line Transients In Automotive Rear Lamp Applications

In automotive equipments, the electric systems or components may be subjected to different supply line transients such as momentary drop in supply voltage, cold cranking, load dump, which can cause supply voltage deviations from the nominal values. Multiple tests, as specified in international standards such as ISO 7637-2 or ISO 16750-2, or specified by the the vehicle manufacturers, should be performed to evaluate the immunity of a device against these power supply transients.

In some transient scenarios, there is big voltage drop in power supply voltages. The $V(\text{supply})$ voltage seen at the power supply pins of TPS92630/8-Q1 may have different conditions, depending on the transient waveforms and the external circuits connected at the power supply pins.

According to the minimum value $V(\text{supply})$ decreases to, the device behavior can be divided into three different conditions, as shown in [Figure 2-1](#). When $V(\text{supply})$ is always higher than 5 V and the device is enabled during the transient, the device keeps working in the normal state. When $V(\text{supply})$ decreases below 1.2 V or the device is disabled, the device will enter power-on-reset state where it will be reset. If $V(\text{supply})$ is between the two voltage levels and the device is enabled, the device behavior is undefined. The fault detection circuits may not be able to keep normal operation. Fault might be falsely detected and reported. If the device detects certain faults it falls into the protection mode and requires a power-on-reset to regain full functionality. So this condition should be avoided.

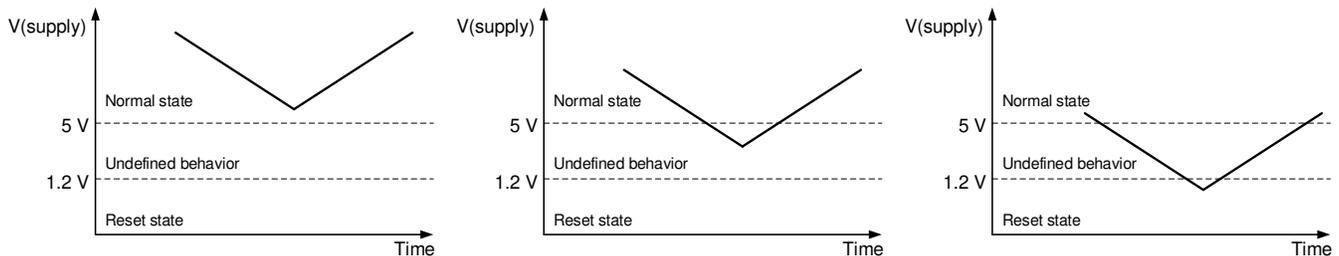


Figure 2-1. Supply Voltage Conditions

If a $V(\text{supply}) > 5\text{ V}$ cannot be guaranteed by the design and no other means of reset after faults (e.g. an MCU) are implemented, the following circuitry described in [Section 3](#) can be used to ensure that the device is disabled when $V(\text{supply})$ is lower than 5 V, so that there will be no unwanted behavior triggered.

3 Recommended Circuit For Device Enable Control

A recommended practical circuit to disable the device according to the power supply voltage is shown in [Figure 3-1](#). A Zener diode is connected between $V(\text{supply})$ and EN and a resistor is connected from EN pin to ground to set a proper working current for the Zener diode.

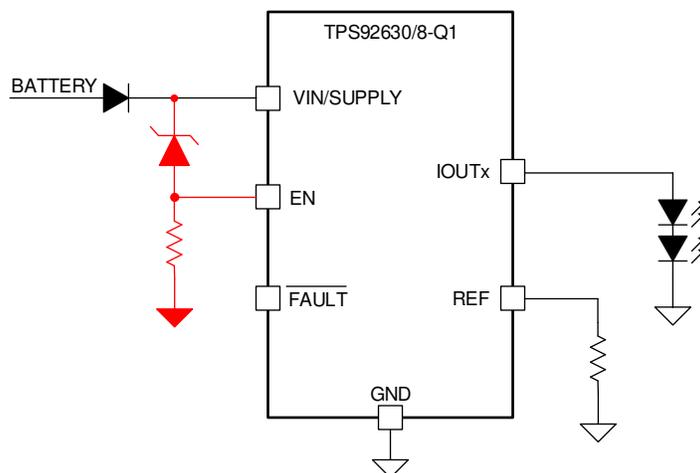


Figure 3-1. Recommended EN Control Circuit

The EN pin logic input threshold is shown in [Table 3-1](#). Select a Zener diode with which you can ensure that the EN pin is lower than 0.7 V when V(supply) is lower than 5 V in order to shut down the device. And the device can be enabled when EN is higher than 2 V as V(supply) increases. For example, using a Zener diode with 4.7 V, 5% reverse voltage, the TPS92630/8-Q1 will be disabled when V(supply) drops to 5.165 V (MIN), and enabled when V(supply) is higher than 6.935 V (MAX).

Table 3-1. EN Threshold Specification

Parameter		MIN	TYP	MAX	UNIT
$V_{IL(EN)}$	Logic input, low level	0		0.7	V
$V_{IH(EN)}$	Logic input, high level	2			V

4 Implementation Results

The application results with the recommended circuit implemented is shown in [Figure 4-1](#). It can be seen that when V(supply) decreases to around 5 V, REF drops to 0 immediately, which indicates that the device is shut down.

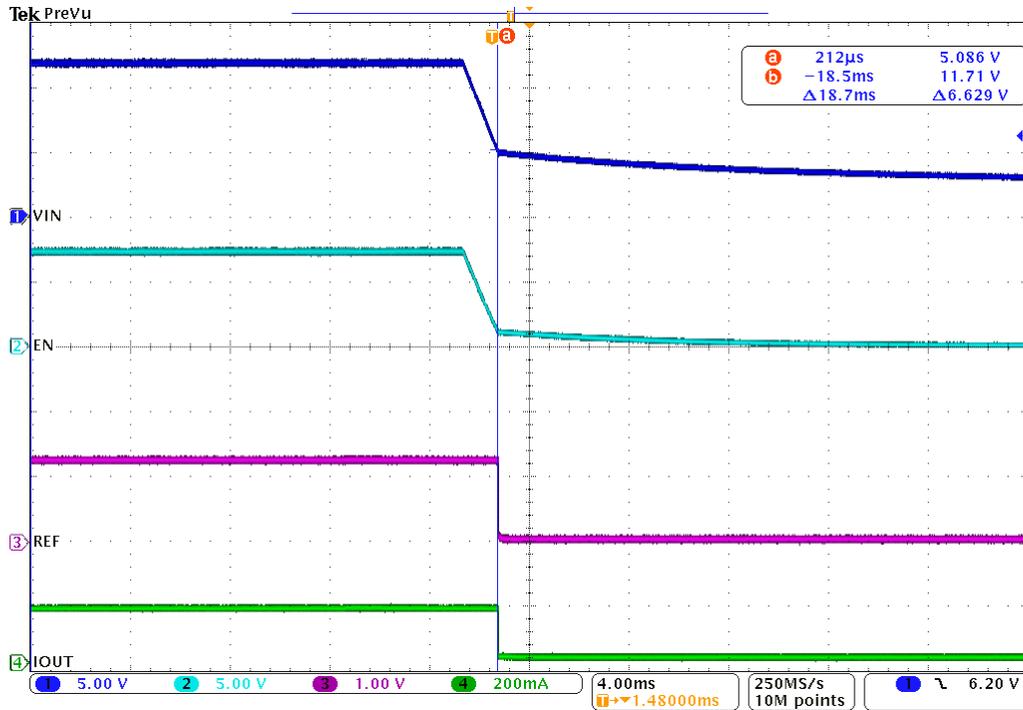


Figure 4-1. Application Curve

5 Summary

This application report introduces the typical design requirements for the TPS92630/8-Q1 device in automotive rear lamp applications to avoid unwanted behavior due to low supply voltage. A simple external circuit can be adopted to make sure the device disabled when supply voltage is lower than the minimum required operation voltage to avoid wrong fault detection.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2022, Texas Instruments Incorporated